REMARKS

In light of the following Remarks, allowance of the above-captioned application is respectfully requested.

The presently pending claims are directed to a novel gas sensor that can exhibit high sensitivity for a wide range of possible analytes. For example, in certain embodiments, the sensors of the present invention can indicate a measurable variation in resonant frequency of the resonator upon exposure to polar as well as non-polar gases. Currently pending independent claim 1 is directed to a gas sensor comprising a resonator that comprises both a dielectric material as well as a layer comprising adsorptive nanostructures. The adsorptive nanostructures of this layer can be either degassed carbon nanotubes, activated carbon fibers, or adsorptive nanowires. In addition, the dielectric material of the resonator is in electrical communication with this layer, such that the effective resonant frequency of the resonator depends upon the dielectric constants of both the dielectric material as well as upon that of the layer comprising the adsorptive nanostructures. New claims 44-63 split the Markush group of pending claims 1-10 into three separate sets of claims.

In the Office Action, claims 1-10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Grimes (U.S. Patent No. 6,359,444) in view of Groger, et al. (U.S. Patent No. 5,514,337). As the secondary reference has been cited only in regard to dependent claim 6, for the sake of clarity Applicants have assumed that claims 1-5 and 7-10 have been rejected as being unpatentable over Grimes alone, and that claim 6 has been rejected as being unpatentable over Grimes in view of Groger, et al. If Applicants have erred in this assumption, clarification of the rejection is respectfully requested.

Grimes is directed to a remote sensing apparatus that needs no direct hard-wire connection and that includes a sensing structure including an antenna in electrical communication with a resonant circuit. At least one component of this sensing structure has a structural element made of a material that selectively responds to an analyte. The sensing structure will resonate at a particular characteristic resonant frequency in the presence of an interrogation electromagnetic field upon the selective response. More specifically, at least one component of the sensing structure may be resistive, capacitive,

and inductive in nature such that the selective response causes a change in electrical characteristics of the at least one component resulting in a change in frequency characteristics of the resonant circuit. (Col. 6, ll. 36-59.)

Grimes does include a single embodiment in which the structural element made of a material that selectively responds to an analyte may include carbon nanotubes. Specifically, and as described at column 15, beginning at line 26, in the embodiment of Figure 2E, a structural element 106 can be located between the resonant circuit 104 and the antenna 108 and "may be in the form of a substrate base-support having a thin-film of carbon nanotubes that selectively respond to (by absorption) hydrogen gas (H_2) as it passes over". Grimes discloses no analyte other than hydrogen gas that the material including carbon nanotubes can be utilized with, nor does the patent include a nanotube-containing absorptive structural element in any other location than that described in Figure 2E, i.e., between the resonant circuit and the antenna. Moreover, there is no suggestion or incentive found in the reference to broaden the teachings of this particular embodiment beyond that which is disclosed, and in fact, the reference appears instead to limit this particular embodiment to only that which is specifically disclosed. For instance, while the patent includes examples of many different materials that can be used in any of the seven different illustrated embodiments (see, for instance the section beginning at column 15, line 41 through column 17, line 7), the carbon nanotube-containing material is disclosed as suitable only for the embodiment of Figure 2E. Accordingly, Grimes discloses a structural element between the resonant circuit and the antenna that is a substrate base-support having thereon a thin film of carbon nanotubes capable of absorbing hydrogen.

The absorptive nanostructures of the present invention, in contrast, can be selected from the group consisting of degassed carbon nanotubes, activated carbon fibers, and adsorptive nanowires. One of the benefits of the present invention is the capability of the gas sensor to respond to an increased number of materials as well as the improved sensitivity of the sensors. For instance, the degassed carbon nanotubes of the sensors can respond to both polar and non-polar analytes as specifically pointed out in new claim 44. Grimes, in contrast, does not suggest methods for increasing either the sensitivity or the number of analytes to which the disclosed sensors can respond, but merely suggests

carbon nanotubes which can absorb hydrogen gas, with no suggestion of first degassing the nanotubes and then maintaining the degassed nanotubes in this state so as to provide responsiveness to polar gases as well as non-polar gases. Applicants submit that there is no proper incentive found to modify the reference's disclosure of absorptive carbon nanotubes to arrive at the very specific nanostructures, and in particular, the very specific adsorptive degassed carbon nanotubes of the pending claims 1-10 and 44-51 that can selectively respond to many more materials than just the hydrogen gas taught by the reference. Moreover, Applicant's further submit that there is no teaching or suggestion at all of either the activated carbon nanofibers of claims 1-10 and claims 52-57 or the adsorptive nanowires of claims 1-10 and claims 58-63. For at least these reasons, applicants respectively submit that the presently pending claims patentably define over the cited reference.

In addition, however, Applicants further submit that the pending claims patentably define over the reference as Grimes does not disclose or suggest a layer of adsorptive nanostructures in electrical communication with a dielectric material such that the effective resonant frequency of the resonator depends upon the dielectric constant of the dielectric material and also depends upon the dielectric constant of the layer comprising the adsorptive nanostructures, as is found in the present claims. In the Office Action, official notice was taken to incorporate a dielectric substrate into the resonator of the apparatus of Grimes as embodied in Figure 2E. While Grimes does disclose the possibility that the structural element made of a selectively responsive material can include a dielectric material (see, for example, the paragraph beginning at column 6, line 60), reference cannot be found in Grimes describing or suggesting a dielectric material of the apparatus in electrical communication with the structural element made of a selectively responsive material and in particular, with that embodied in Figure 2E. Nevertheless, in the Office Action, an additional dielectric material was incorporated into Grimes absent any evidentiary support to do so. Following incorporation of this new dielectric substrate into the resonator of Figure 2E of Grimes, absent any evidentiary support to do so, this dielectric substrate was then placed in electrical communication with the carbon nanotube

layer of Figure 2E of the reference and the carbon nanotube layer was then modified to include degassed carbon nanotubes in order to arrive at the pending claims.

Applicants respectfully submit that no citation to any reference work has been offered as evidence to support this inclusion of an additional dielectric substrate in the resonant circuit of Grimes. Applicants respectfully request either evidentiary support for this addition to the disclosure of Grimes or withdrawal of this rejection.

In the Office Action, Grimes was combined with Groger, et al. to arrive at the limitations of dependent claim 6. Applicants respectfully submit that claim 6 patentably defines over the cited references for at least the reason that it is a proper dependent claim of an allowable independent claim, as discussed above with regard to independent claim 1. However, Applicants further submit that the patentability of the dependent claims, including dependent claim 6, does not hinge on the patentability of the related independent claims.

For example, in regard to dependent claim 6, Applicants respectfully submit that there is no reason to combine the references as suggested in the Office Action. Specifically, in the background section of Grimes, the Groger, et al. reference is mentioned as an example of previously known chemical sensing technologies that require the operation of complex, specifically tailored sensing units electrically connected, to monitor a target analyte (Col. 1, ll. 46-65). The remote sensing capability of Grimes, in contrast, is described as an improvement over these previously known sensing technologies, e.g., a versatile robust chemical sensor for obtaining information in various environments through remote query, without requiring direct electrical connection to a receiving device (col. 4, ll. 8-14). As such, Applicants respectfully submit that when taken as a whole Grimes itself teaches away from combination with the teachings of Groger, et al. as the reference itself is explicitly taught as an improvement over Groger, et al.

It is believed that the present application is in complete condition for allowance and favorable action, therefore, is respectfully requested. Examiner Bellamy is invited and encouraged to telephone the undersigned, however, should any issues remain following consideration of this response.

Please charge any additional fees required by this Amendment to Deposit Account No. 04-1403.

Respectfully submitted,

DORITY & MANNING, P.A.

7/1/05
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